System Engineering the Battle Force

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What is it?

- Force level systems engineering is an end-to-end process to achieve effective war fighting capability in a network of distributed warfare systems.

Evolution of Systems Engineering Process

Vicksburg/ Hue City out of action for 18 mos. due to interoperability problems

CFFC 231400Z MAY 03 / Fleet Reponse Plan (FRP) Implementation

Reagan Strike Group Collaborative Test

"Engineering in" interoperability at the System of systems and Family of Systems level for Force level capability

Where We Were **Where We Are** **Where We Are Going**

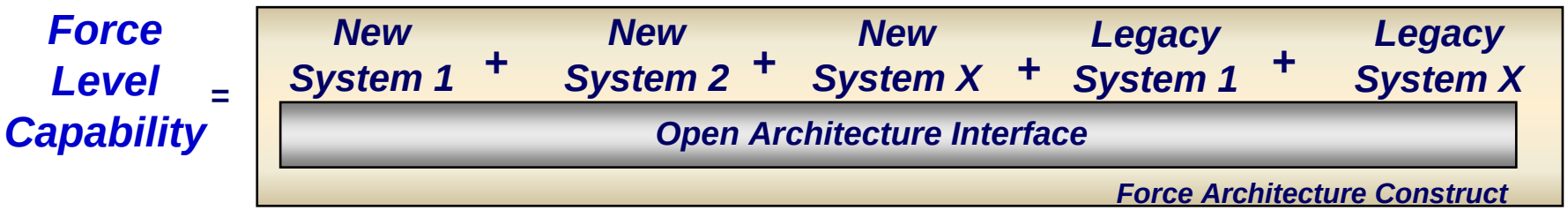
Single system modeling, test and performance assessment (i.e., radar models, missile 6 DoF, element and system performance analysis)

The Distributed Engineering Plant (DEP) is a critical element of the Navy's response to Battle Force Interoperability crisis of the 1990s

DEP goal is to enable acquisition decisions based on sound force system engineering

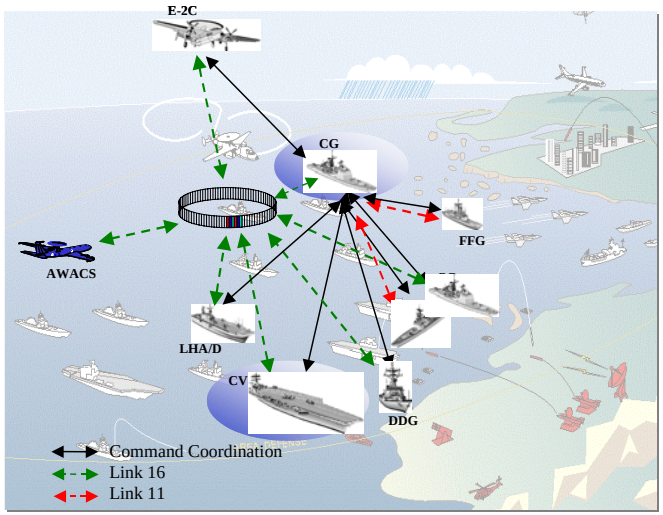
Achieving Force Level Capability

- Understand system, system interface, & architecture requirements at all levels and from all views (i.e. Platform, system, warfighter, Force, Coalition)
- Integrate networked, distributed warfighting systems from design through certification to deployment
- Coordinate and collaborate across organizational, process, and Sea Power 21 Pillar boundaries



Example of Warfare Generation

From Mission Threads to Combat Systems



AAW Force Interoperability Hierarchy

Campaign Accomplishment

- Units Needed to Win
- Red Losses
- Blue Losses
- Time Needed to Win
- Fratricide

Force Capability

- PRA
- Weapon Efficiency
- Kills
- Leakers
- Fratricide losses

Engagement Coordination

- Layers Employed
- Expenditures
- Wasted Expenditures
- Engage Pk
- Effective Firepower
- Wasted Firepower

Engagement Effectiveness

- Engage Decision Delays
- P(Hostile Engage)
- P(Fratricide Engage)
- P(Duplicate/False Engage)
- Track Range
- Engage Range
- Coord. Efficiency

Interoperability

- Clarity
- Completeness
- Continuity
- Kinematic Accuracy
- Commonality

Combat Systems

- Connectivity
- Info Management
- Data Exchange
- Data Registration
- Track Integration

Clear requirements and performance assessment at all levels are required to ensure mission capability

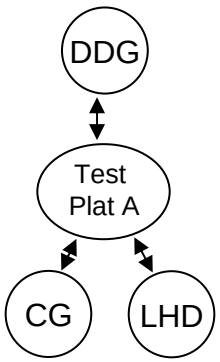
Notational Platform and Strike Force Certification Approach

Other Platform Level Certification test/requirements
PEO Integration/ CSIT Test Phases
Developmental DEP and Live I/O Test

Force Level
I/O Test and Characterization
Deployment Preps

Platform Testing | **IPCD** | **Availability** | **PCD** | **SFCD**

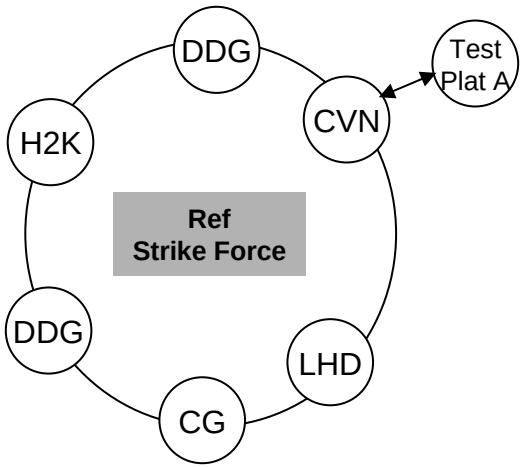
Basic Platform I/O Test



-- Functional Operability Test
-- Point to Point
-- Representative Combat Systems

verifies key functionality

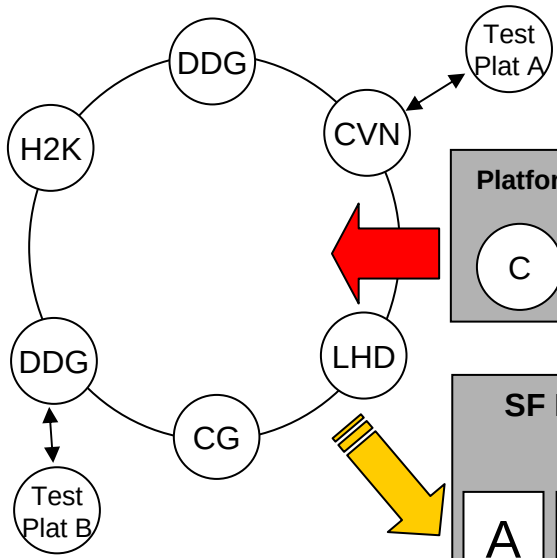
Advanced Platform Interoperability Test



Results of Warfare System Upgrade impacts on Ref SG Metrics
-- Better?
-- Worse?
-- No significant change?

impacts on baseline interoperability performance

Strike Force Interoperability Test



platform to platform I/O interaction

Historical SFIT Results

Platforms/Baselines Available within FRP

C | D | E | F | G

SF I/O Characterization of FRP Specific Platforms

A | B | C | D | E | F

Good-With Restrictions-Not Recommended-Unknown

JDEP

JDEP is DoD-wide capability for Service and Joint engineering, integration, and test resources to provide system-of-systems, battlefield representative environments in support of developer, tester, and warfighter requirements

Doctrine and operations are increasingly dependent on Joint SoS

- Demands new approaches to SoS development, integration, test and assessment
- Addresses need by providing users the means to create SoS environments by linking existing capabilities

Capabilities shared and applied in different configurations to address SoS issues

- JDEP supports users to select/configure the existing resources, using common reusable assets, to address interoperability issues

Conclusions

- Evolution to systems engineering of an interoperable force requires a comprehensive investment in the force systems engineering process
- Clear requirements and performance assessment at all levels are required to ensure mission capability
- Cross-organization, cross-process, and cross-pillar collaboration are critical to Battle Force Systems Engineering
- Force systems engineering translates into providing critical, operational, capability to the warfighter

Back-up

Engineering Force Level Capability

NAVAL MISSIONS

- Sea Shield
  - Force Protection, Surface Warfare, Undersea Warfare, TAMD
- Sea Strike
  - Strike, Fire Support, Strategic Deterrence
- Sea Basing
  - Deploy & Employ, Integrated Joint Logisitics, Pre-Positioning Joint Assets Afloat
- FORCEnet
  - Intel, COP, Networks

Requirements

EFFECTIVENESS

- Force Structure
  - # of Platforms
  - Platform Organic Capability
- Multi-Mission Platforms
  - Combat System Capability
  - Weapons System Capability

Requirements

EFFICIENCY

- Platform Versatility
  - Integration of Missions
  - Connectivity
    - COP, CUP
    - FORCEnet
  - Distributed Capability
  - Force Interoperability
  - Crew - Size, Capability & Training
  - Combat Systems
    - Building Blocks of Force Capability

Force Level Warfare Systems Engineering

R&D, S&T and T&E

Technology

Systems

- ARCI
- Rail Guns
- EM Weapons
- Integrated Flexible Mast
- ASTO
- Artificial Intel
- Manning / HSI
- UUV's / UAV's
- Etc

Investment Strategy

Technology Insertion

Development of Plans, Processes and Procedures

Platforms / Systems

Systems

Mechanical

- Weapons Mix

Electronic

- Internal Functions
  - Applications
- External
  - ForceNet, COP,CUP

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Tools, Policy and Standards

- Joint, Distributed Engineering Plant (JDEP)
  - DoD-wide capability for Service and Joint engineering, integration and test resources
- Naval Warfare Systems Certification Policy (NWSCP)
  - Joint SYSCOM instruction
  - Common process for certifying platforms and strike forces, with linkage to top-level requirements
- C5I Modernization Policy (in support of Fleet Readiness Policy)
  - CFFC Instruction
  - To ensure improvements are interoperable, certified, & provided with proper training, and ILS.
- SYSCOM participation in Naval Capability Development Process (NCDP)
  - Cross-SYSCOM, cross-pillar adjudication of issues
  - Increased emphasis on capabilities required for delivery on a Battle Force vice platform level
- Pursuit of single, DoN, systems engineering process
  - Systems Engineering Steering Group
- Exercise of Technical Authority
  - Joint SYSCOM instruction

Common theme of synchronization

Naval Warfare Systems Certification Policy
Phased Approach

- **Phase I: Promulgate NWSCP to define FRP compliant platform and strike force certification policy with emphasis on Navy surface platforms**
  - Air and subsurface platforms addressed as part of SF Interoperability Certification
  - Revisit certification criteria
  - Clarify roles within the certification construct

Phase I – Awaiting SYSCOM Approval

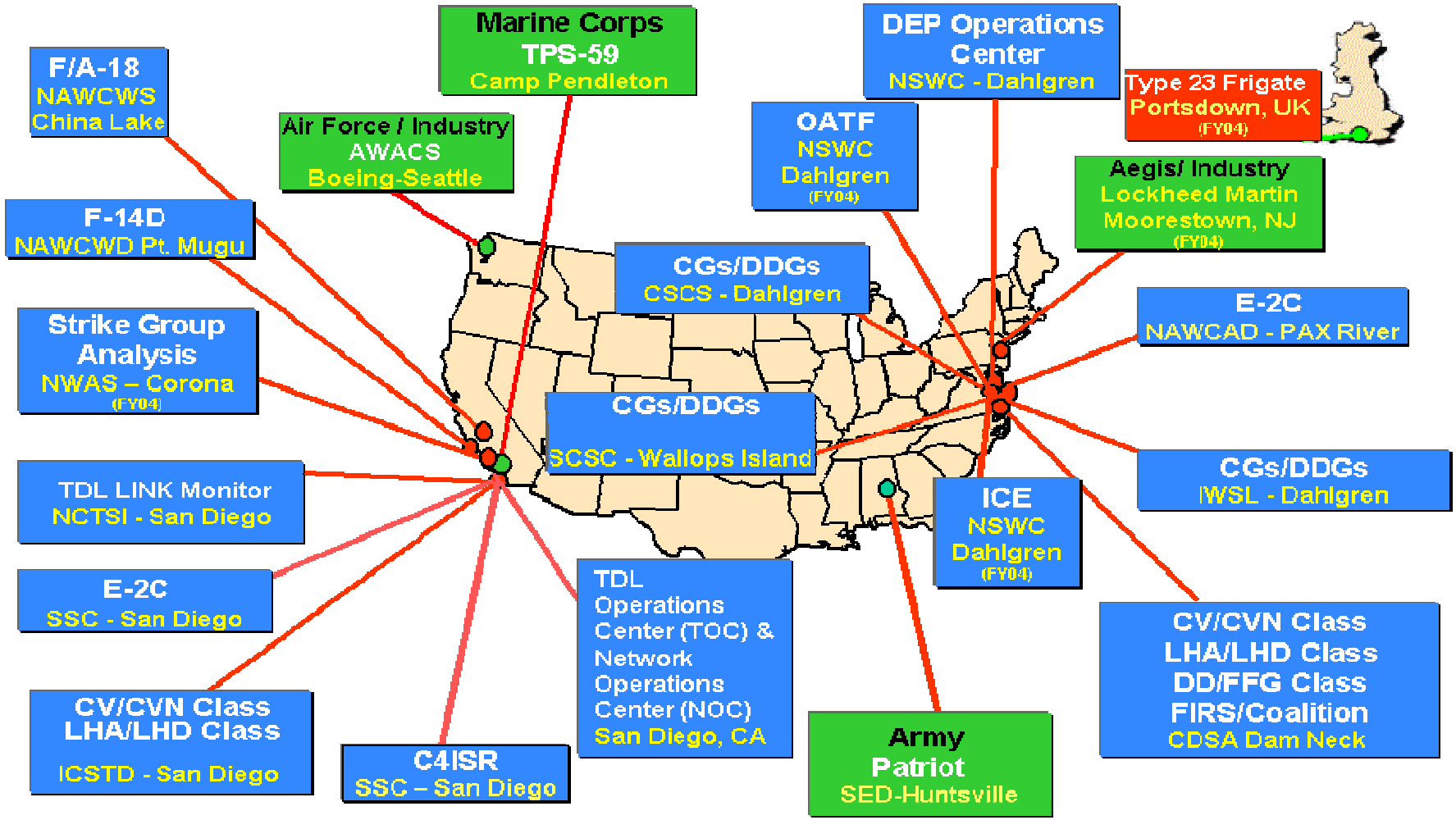
- **Phase II: Update NWSCP to focus on defining platform and strike force certification policy across the SYSCOMs**
  - Increase Joint SYSCOM participation in NWSCP development
  - Integrate unique and complementary warfare system certification policy and processes for air and subsurface platforms

Phase II - Complete February 2006

- **Phase III: Update NWSCP Phase II to align with the acquisition process**
  - Alignment of certification policy and processes with acquisition process (DoD/SECNAV 5000 Series)
  - COMOPTEVFOR involvement

Phase III - Complete March 2007

Growing the DEP/JDEP Network



Navy Participation in JDEP Efforts

- **Past JDEP Events**
  - JDEP Track 1
  - JSSEO Joint Combined Hardware-in-the-loop Event Phase 1
  - Navy Sponsored Joint Test Event (NJTE)
  - DT801-IIIG Risk Reduction JDEP Event
  - STRATCOM Early Warning
- **FY05 JDEP Plans**
  - Sea Based BMD Event / STRATCOM EW
  - JCHE Phase II
  - Air Force Critical Area Air Defense Phase IV
  - Multi-Service Distributed Event

Platform and Strike Force Interoperability Certification Approach and Event Descriptions

Requirements Review

Translate Top Level Requirements to Platform Interoperability Certification Requirements
- Interpret Joint and Navy requirements (CRD's, NMETLs)
- Leverage IER's, SIAP and other objective measures and thresholds, as appropriate
- Reference missions and architectures
- Establish performance baseline (reference Strike Force/metrics)
- Formal reset of baseline defines

Basic Platform Interoperability Test

Basic Platform Interoperability Test (BPIT)
- Supports IPCD and is conducted as part of the WSI²T
- Expansion of Multi-Platform Interoperability Test (MIT) which is currently conducted during WSI²T. BPIT adds actual combat systems in a DEP environment
- Representative of typical surge interaction (AEGIS, Non-AEGIS, CEC/Non-CEC)
- Basic Platform Interoperability Test verifies key functionality (ID Diff, Force Orders, track management, etc.) and ensures readiness for advanced testing
- Basic Platform Interoperability Test maintains functional focus, vice Force-level metrics analysis

Advanced Platform Interoperability Test

Advanced Platform Interoperability Test (APIT)
- Supports PCD and is conducted as part of Interoperability Assessment (IA) Event
  - Near-Term (USS REAGAN) – Characterization of Interoperability Performance within Representative Strike Force in terms of Issues and CAPS & LIMS
  - Long-Term - Results of Warfare System Upgrade impacts on Ref SG Metrics in terms of Better, worse or No significant change
- Comparative approach measures test platform impacts on baseline/interoperability performance, i.e., reference or benchmark Strike Group performance
- Reference Strike Group performance defined using SIAP Attributes initially to cue root cause analysis
- Future iterations may introduce additional metrics and/or reference models
- May test two moderate upgrades concurrently to maximize test efficiency

Strike Force Interoperability Test

Strike Force Interoperability Test (SFIT)
- Supports SFCD, which occurs prior to routine deployment
- Continuous test process focused on addressing high priority Interoperability items of interest for specific FRP platform to platform interaction based on inputs from Fleet and CAPs & LIMs
- Characterizes surge platforms for CFFC to consider when assembling deploying SFs
- Produces Interoperability rating (good, with restrictions, not recommended, unknown) with other surgeable platforms/baselines, integrated with Strike Force Training and SF CAPs and LIMs efforts

Translation to Fleet Products

Platform Limitations and Impacts Defined in Technical and Operational Terms
- Assigns impacts to PEO/PM systems engineering process for resolution
- Operational impacts drive Fleet/sponsor priority/funding decisions
- Process integrates Fleet Training/BF Caps and Lims/etc to flow issues toward TTP and other mitigating procedures
- Provides Fleet with information necessary to optimize SF compositions and optimize performance within assigned architectures

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Focus Areas

- WSI^{2}T Testing Requirements
- Platform Level Warfare System Certification Policy for Aircraft and Subsurface Platforms
- Strike Force Certification
- NWSCP alignment with SHIPMAIN
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- NWSCP Alignment with FORCEnet
- Open Architecture
- C4I Certification

- Other Areas of Interest
  - Certification vs. Assessment
  - Virtual SYSCOM Oversight
  - Technical Authority
  - LCS/DDX Certification Planning
  - SCN/New Construction Certification Planning

The Role of Technical Authority

Program Management Challenges:

DODINST 5000.2

PPBES schedule driven process

JCIDS Capabilities based requirements

System-of-systems increase in complexity

Higher technology investment cost

Initiatives to reduce support infrastructure, crew size, life cycle cost

All add up to increased technical and programmatic risk

- Setting Technical Standards
- Subject Matter Expert
- Assuring Safe and Reliable Operation
- Judgment in Making Technical Decisions
- Effective and Efficient Systems Engineering
- Stewardship of Technical and Engineering Capabilities
- Technical Accountability

Technical Warrant Holder responsibility:

Is the engineering process sufficiently complete and sufficiently rigorous to provide an acceptable level of risk in fielding a system?

Engineering Leadership ensures a balanced approach